Sources of Liability for Geologic Hazards

The range of liability for damage from geologic hazards has a basis in common law and consequently is explicit in most states as such or as modified by statute.

The range of liability extends from absolute through phases of contingent to limited or no liability. In general, absolute liability in civil cases is imposed for acts which are ultrahazardous, inherently dangerous, or public nuisances. Contingent liability exists where an act or omission is intentional or the result of a breach of a duty which leads to a foreseeable damage. Liability is limited or there is no liability where the damage resulted from an act of God, where there were supervening acts of others or where no legal injury occurred. For each potential attachment of liability, there is a defense or range of defenses. In addition, persons who speak out in a defamatory manner may incur liability for that speech unless protected by privilege or on constitutional grounds.

The legal basis for liability for damage from geologic hazards is in tort and property law (including water law) where traditionally the different degrees of liability have been imposed for differing damages to land and the use of land. Loss of vertical support, flooding, and pollution are commonly absolute liability or intentional torts. Damage from landslides and mixed geologic situations commonly fall under the rules of negligence and one would expect the same to apply to damage to man-made structures from earth movements. Interferences with groundwater supplies may result in civil liability depending on one of the four major theories of groundwater law.

Professional geologists in public practice or those who involve themselves in public debate without adequate preparation are likely target defendants where damages result from projects which incorporate their recommendations, where they fail to act when there was a duty to do so, and where their unwarranted alarms cause expensive delays.

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Exploitation of Very Low-Grade Uranium Deposits

Where once there was great optimism about the economic exploitation of very low-grade uranium deposits (0.002 to 0.010% U_3O_8) such as occur in the Chattanooga Shale and the Conway Granite, there now is almost equivalent pessimism. A 1978 National Research Council report "rules out" shales and granites as future uranium sources, because of the "enormous" mining and processing costs required and because the environmental impacts of the "many huge operations" that would be needed are not likely to be acceptable. Such a conclusion appears premature. Gold is won at an after-tax profit from deep-mined refractory ores in which it is found in concentrations as low as 3 ppm (0.0003%), much lower than the low end of the range cited for uranium in shales and granites; the price-grade relations for gold suggest that 0.006% U_3O_8 rock could become ore at a price well below $150/lb. The energy balance appears positive even for once-through LWR burning; with breeders, it would be strongly positive. To meet the projected 1980 United States annual requirement of 19,000 short tons of U_3O_8 from a single mine in rock containing 0.006% U_3O_8 at 70% recovery would require moving a minimum of 1.24 million short tons of rock a day—a large amount, but easily within the ability of present technology (5 or 6 large copper pits would be the equivalent), and possibly not unacceptable in a time of energy scarcity. The major constraint on potential uranium supply remains political, rather than geological or technological.

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Generation of Debris Flows and Turbidity-Current Flows from Submarine Slides

Relatively few data have been published that demonstrate that sediment gravity flows can be generated from slides and slumps. Such evidence can be found in a north-trending, seaward-prograding, continental-slope sequence which existed in central Nevada during the early Paleozoic. Translational slides on this slope are up to 400 m wide and 10 m thick. These slides moved semi-lithified, black, thin-bedded, hemipelagic limestone. Once the slide was in motion its transformation into mass flows began at its base and thin margins. Probably the rupture strength of these parts of the slide was exceeded and movement by plastico-viscous flow resulted because of a variety of factors which includes strain, mechanical shock, and incorporation of water. The development of clasts in the basal shear zone and thin margins of the slides resulted from overfolds and nearly horizontal beds within the slides which gradually separated into thin tabular fragments. Clast development progressed as the slide continued to move downslope until the base and margins of the slide attained a completely conglomeratic texture. The clasts at this stage assumed a random or subparallel orientation supported by a carbonate mudstone matrix.

Conglomeratic debris-flow deposits generated by these slides occur in channels up to 400 m wide and 12 m thick. Field data suggest that a downslope transition occurs from debris flow to turbidity-current flow. Many of the conglomeratic turbidity-current flows on the lower slope probably originated as debris flows which in turn were generated from slides higher on the slope. These turbidity-flow deposits occur in channels up to 100 m wide and 2 m thick and contain clasts identical to those in the debris-flow deposits.

A further genetic link may exist between these slides and the slide-generated mass-flow deposits. The mechanics of flow and the resulting fabric and sedimentary structures in the mass-flow deposits were influenced by the nature of the clasts generated by the slides. Preliminary data suggest that the size, shape, and original orientation of the slide-derived clasts were strongly controlled by the bedding characteristics, degree of induration, and style of deformation of the slides.

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